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Results of experiments with nodule-disease of the intestines of sheep

William Haddock Dalrymple

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LOUISIANA STATE UNIVERSITY AND A. & M. COLLEGE.

WM. C. STUBBS, PH. D., Director and State Chemist.

Results of Experiments with Nodule-Disease of the Intestines of Sheep

BY

W. H. DALRYMPLE, M. R. C. V. S.

ISSUED BY THE STATE BOARD OF AGRICULTURE AND IMMIGRATION,
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VETERINARY DEPARTMENT, STATE EXPERIMENT STATION

BATON ROUGE, LA., APRIL, 1904.

Dr. W. C. Stubbs, Director.

Dear Sir:—I beg to submit, herewith, the MSS. of a bulletin covering the results of experiments with Nodule Disease of the Intestines of Sheep, which have extended over several years. As the results of the early part of this work were published in Bulletin No. 74, I have taken the liberty of reproducing them in this, besides the greater part of the article on the disease, so that the continuity might be preserved, and the subject matter presented in its entirety in this bulletin.

Very Respectfully,

W. H. DALRYMPLE, Veterinarian.

LOUISIANA STATE UNIVERSITY AND A. & M. COLLEGE

BATON ROUGE, LA., APRIL, 1904.

Major J. G. Lee, Com. of Agriculture and Immigration,

Dear Sir:—I enclose you the results obtained by Dr. W. H. Dalrymple from some experiments, extending over several years, investigating the Nodular Disease of Sheep. These results suggest distinctly a method by which both sheep and pastures may be relieved of this great obstacle to successful sheep raising in the South.

I ask that this be published as Bulletin No. 78.

Respectfully submitted,

WM. C. STUBBS, Director.

RESULTS OF SOME EXPERIMENTS WITH NODULE-DISEASE OF THE INTESTINES OF SHEEP.

W. H. Dalrymple.

In order to give our readers an intelligent conception of the disease with which we have been experimenting, viz., "Nodule-Disease of the Intestines of Sheep," and the object of such experiments; also to preserve the continuity of the work, which has covered several years, we have taken the liberty of reproducing, in part, at least, the article on the subject, and, likewise, the whole of the first part of the work, which appeared in Station Bulletin No. 74, so that the entire subject matter might be given in connected form in this report. It is unnecessary, however, to introduce the disease by entering into a lengthy detailed history of its early occurrence, identification, prevalence, etc. Suffice it to say, that there is hardly a State in the Union that can claim freedom from it among its flocks. For some time it had been mistaken for tuberculosis, the nodules, or tumors, on the intestines resembling, somewhat, the tubercles of consumption; but later investigation revealed the presence of a very minute round worm as the true cause.

The disease gets its name from the nodulated condition of the intestines, they being, in advanced cases, thickly studded with nodular enlargements all along their course, as far back as the last portion of the bowel (rectum). Everyone who has butchered sheep, in many sections of the country, must be familiar with the appearance, although, perhaps, ignorant of the cause of this condition, known popularly, in some localities, by the term, "knotty-guts."

In the adult stage, the worm, or parasite (Oesophagostoma Columbianum) is about one-half an inch in length, and may be found located in the intestines, and more particularly, the large bowel. The immature stages or forms, vary in length from 1-100 to 1-6 of an inch, depending upon age and stage of development. These are found encysted in the nodules. The writer has dissected quite a number of the larger, older, tumors, without finding the parasite in them, and from which we would infer that they had escaped into the intestine. The life-history of this minute worm, so far as appears to be known, from the more recent investigations, is as follows: The mature female lays her eggs in the intestine. The eggs hatch in a short time, and the embryos, or minute immature worms, pass, in some manner, through the mucous, or internal, lining of the bowel, and become encysted or embedded there; and the irritation produced by the worm seems to give rise to the nodules or tumors, which can be seen, of various sizes, projecting from the intestine, sometimes along its entire course.

INTESTINES SHOWING NODULE DISEASE.

The tumor consists of a cheesy material, often greenish in color, which, on breaking its outer covering, can be squeezed out. It is thought by Dr. Curtice that the embryos are the chief cause of the trouble, and that the adult worms produce but very little, as the latter are comparatively few as compared with the number of tumors. Some of the adult parasites, and probably some of the eggs, pass out from the intestines with the manure, and in this way pastures and other feeding quarters are infected; and in turn, shallow and sluggish watering places into which they drain. There is however, a stage in the life cycle of the worm that seems to be still undetermined. That is, from the time it leaves the bowels with the manure until it is again found in the tumors on the intestines.

The symptoms of nodular disease are not very characteristic during life. In fact, there must be thousands of fat sheep slaughtered annually in the abattoirs of the country affected with this ailment, which exhibit no special indications previous to being killed. But in the more advanced stages of the disease, the symptoms resemble those seen in other parasitic troubles, such as general debility and in the most severe cases rapid emaciation, and excessive diarrhoea. A positive diagnosis can only be made by post-

mortem examination and finding the characteristic nodules on the intestines. The cause of death in acute cases is evidently the interference caused by the tumors to the process of absorption. Or, in other words, the animal is deprived of proper nutrition on account of the function of the intestinal walls being interfered with by the tumors, and the process of absorption of nutrient material thereby lessened. The extent of the derangement may be said to be in direct ratio to the number of tumors present.

The treatment so far suggested is chiefly preventive, although we believe the best results would be obtained from a combination of both preventive and curative, when handling an infected flock. The chief drawback to the desired effects of medicinal treatment is the embedded or encysted position of the parasites in the tumors which seem to be beyond the reach of medicines. Still, as adult worms are found free in the bowels, vermifuge medicines would necessarily have some effect upon those in this situation. The gasoline treatment, used in stomach-worm disease, has been recommended. A weak solution of creolin seems to have given favorable results in the hands of Dr. M. Jacob, of the Tennessee Experiment Station, a report of which he gave in a paper read before the United States Association of Experiment Station Veterinarians, at Atlantic City, N. J., in September, 1901. We quote from his paper the following: "Sheep had been dying at the rate of four or five a week. They had been put in a new field about six weeks previously, but still continued to die until after they had received, daily, about 20 minims of crude creolin per head. This was prepared in the form of a drench by dissolving 5 ounces of creolin in one gallon of water, and giving each sheep about one ounce a day for ten days. This treatment seemed to give pretty fair results, for during the next two or three months the death rate was very markedly decreased." Dr. Jacob thinks the treatment ought to be continued for at least one month. The individual treatment of sheep, where there are large numbers of them, is an undertaking which but few of our sheep owners in the State would attempt, except, perhaps, in the case of the animals being valuable pure-breds. Dr. Cooper Curtice also states, however, "that in case medicinal remedies are tried, each animal must be dosed."

Those who are at all familliar with intestinal parasitic diseases are aware that medicinal treatment alone will not yield satisfactory results, but that other measures, outsides of the animal, must likewise be adopted. For, to attain our object, we must not only endeavor to destroy the parasites in the animal but we must also treat

the infected pastures to destroy or render innocuous the parasites that may be on their surface, and capable of infecting animals (sheep in this case) grazing over them. A combination of both, then, is necessary for the most satisfactory results. Curtice remarks, "that the same care in changing pastures, in providing good drinking water and a plentiful supply of salt, should be observed in this disease as for other parasites. Judicious fall and winter marketing of infected sheep will also tend to lessen the chances of infection. If pastures are known to be permanently infected, then they should be turned over to other stock for a year or two before being again grazed on by sheep. When it is practical, on the smaller farms, the sheep lots should be plowed, and either planted or left fallow. The object of change of pasture and of plowing is nearly the same; in the one case to wait until the parasites have died out; in the other, to bury them beneath several inches of soil, from which the sheep owner may rest assured they will not emerge."

EXPERIMENTS.

In order to make a practical test of the question, for our own satisfaction, as to whether a pasture would become infected after being occupied by sheep affected with nodular disease, and the same pasture afterwards capable of transmitting the disease to healthy lambs, an experiment was commenced at the State Experiment Station on April 10, 1901, by confining three sheep from an infected flock on a small pasture lot, of about one-quarter of an acre in extent, which had not had sheep on it for at least thirteen years.

On February 2, 1902, one of the sheep died, after presenting the usual symptoms of internal verminous disease, such as general debility, emaciation, anaemia, etc., accompanied by loose bowels for two or three weeks previous. An autopsy revealed great numbers of nodules along the course of the intestines.

In order to obtain lambs free from nodular disease to place upon the pasture lot (after the infected sheep had occupied it from April 10, 1901, till about the beginning of May 1902), several pregnant ewes were purchased by the station and placed in a shed with floor kept clean and sprinkled over with sawdust. Grain was fed to them out of troughs, and green oats, or other soiling crop, out of racks, and they were watered from low-sided tubs or buck-

ets. These ewes were suspected of having nodular disease and which proved to be the case, later, when autopsies were made.

After the lambs were born (between March 25th and April 19th, 1902) the following method was adopted in raising them until they were able to be placed on the lot with the infected sheep: A long shed was used, which was divided off into three compartments, with small gates between each. When separated, the ewes occupied one of the end compartments, and the lambs the other, leaving an empty one between. During the suckling periods the bars were lowered, and mothers and lambs allowed to come together in the middle compartment. As soon as nursing was over they were again separated into their respective compartments, and in this way were kept from one another, except during the suckling periods, to avoid contamination as much as it was possible.

Four lambs were saved out of half a dozen, two dying from the effects of cotton seed meal, which was an ingredient of a grain mixture fed when they were thought to be old enough to eat a little concentrated food.

On May 3rd and 5th a lamb, with its mother, was placed on the infected lot.

On July 24th the first lamb died. Post-mortem revealed a number of small nodules on the large intestine, and a tape-worm (taenia expansa) in the small bowel.

On August 22nd the second lamb died, and a number of small nodules were found on the large bowel; a tape-worm in the small bowel; and great numbers of twisted stomach worms in the fourth compartment of the stomach.

The autopsy on the first lamb that died was made by one of the college students during the temporary absence of the writer on State Farmers' Institutes, and stomach worms were not examined for. But it is our opinion that these worms were the cause of death in each case. Still, that did not vitiate the results of the test so far as nodular infection was concerned.

It should be stated that, although we commenced with only three infected sheep, we had as many as eight infected animals on the small lot during the time the two lambs were on it.

As a control experiment, the other two lambs, which were born and raised under similar conditions to the first two mentioned, were kept in a large clean box stall, were fed a little grain and green stuff (after they were weaned), and were afterwards staked out during the day on different parts of the horticultural garden, close by, but away from any opportunity of obtaining nodular infection.

These two lambs remained in a healthy condition and continued to thrive, weighing, together, 108 1-2 pounds, gross, when they were butchered on November 1st, 1902.

On post-mortem examination their intestines were absolutely free from nodules.

So far as this experiment goes, it simply substantiates the general opinion held by helminthologists, with respect to the entozoa (internal animal parasites), viz., that infection is spread to pastures through the medium of animals infested with parasites, and that previously sound animals may obtain the infection, afterwards, through grazing upon such pastures.

A knowledge of the fact, then, that a pasture may become infected through the medium of diseased sheep occupying it, and that sound lambs may obtain the infection by grazing upon it, either in company with infected sheep, or within a reasonable length of time after the latter have been removed, is of the utmost importance to our sheepowners. But, they should also be familiar with the more intelligent methods for the elimination of the infective agent (the parasite) from the pasture.

As may be inferred from the foregoing, a great many, probably the majority, of intestinal worms spend only a portion of their life-history in the body of the host on which they are parasitic, the other part being spent outside on the ground, or, sometimes, even in the body of some intermediate host, as is found to be so with tape-worms, fluke-worms, etc.

In the case of the minute round worm (nematode) which produces the nodules on the intestines of sheep, it would appear that, at least, some of the worms, or their eggs, escape with the bowel discharges on to the surface of the ground, and from there are taken up by other animals, causing, in sound ones, infestation, and, in the case of those previously diseased, re-infestation.

The inference to be deduced from this cursory glance at the life-history of intestinal parasites, such as the one under consideration, therefore, is, that, in addition to the administration of remedies directed to the destruction, or expulsion, of worms from the host in which they attain maturity, some treatment should be afforded the pasture that has become infected, and harbors the parasite in one or more of its stages. And, if this part of the treatment should be overlooked or neglected, the successful eradication of this, or other similar ailments of sheep, cannot reasonably be expected.

It was with the view of freeing the pasture of parasitic infection that the following experiment was undertaken, the details of which we now proceed to give.

The pasture-lot in which the experiments were conducted as before stated, is about one-quarter of an acre in extent, and fenced in with wire netting to protect its occupants from the possible ravages of dogs running at large. At the conclusion of the first experiment, this lot, which was then in an infected condition, was, on October 25th, 1902, ploughed up; considerable care being exercised during the operation to have the surface turned under as effectually as possible, and, close up to the fence bottom, where it was difficult, or impossible, for the plough to reach, a spade was used to complete the work over the entire area. The object aimed at in doing this was to bury the infection (worms, their eggs, or immature forms) beneath the sod so inverted.

On November 1st, 1902, this lot was sown to oats, from which an excellent crop was cut for hay on April 26th, 1903.

In order to again obtain a few sound lambs, that is, free from nodule disease of the intestines, to place upon the lot after the pasturage (Bermuda grass) had attained sufficient growth to afford them sustenance, three grade-ewes were procured from a farmer in a neighboring parish on April 3, 1903. One of the ewes came with a one-day-old lamb, the other two being within a short time of lambing. The flock from which these sheep were obtained had been affected with nodule disease for several years, at least, to the writer's personal knowledge. Similar preparations were made for the reception and care of this lot of ewes and lambs as for the bunch mentioned in the last experiment, viz., a shed divided into three compartments, connected by small openings with a gate on each. The two end compartments were occupied, respectively, by the ewes and the lambs, so as to keep them separate, except during the periods of nursing, when they were brought together in the center compartment (the floor of which was covered with sawdust and kept free from droppings all the time), and immediately separated again when suckling was over. The purpose here was to avoid, as in the previous case, contamination of the lambs through contact with the excrements from their mothers, or material they might eat, that should, perchance, have become soiled by parasites extruded with the manure.

On April 15th, the second lamb was born; and on the 18th, the third. Two of the lambs were grade-Dorsets; the other, a grade-Southdown.

Besides the mother's milk, to which they had access thrice daily, it not being convenient to permit of their suckling oftener, they were allowed a little green feed and a small quantity of crushed grain in their compartment, both of which they soon learned to eat and to relish.

On April 26th, the mother of the Southdown-grade lamb died from tetanus (lockjaw), the result of infection of a large wound produced by a projecting nail when the animal was rushing hurriedly through one of the gateways. So that the two remaining ewes had to take their share in supplying the orphan lamb with milk, and which they managed to do without any apparent difficulty.

On June 18th, the three lambs were turned out on the pasture lot, during the day only, sufficient growth having developed for them to graze on, and they were nursed in the morning, previous to turning out, and in the evening after being housed. This arrangement continued for a few days, when, on June 26th, the ewes went dry, and the lambs were allowed to remain in the lot from this time on, a small quantity of crushed grain and fresh water, given them daily, and they had a small, but suitable, temporary shed provided for protection against both rain and the excessive heat of the summer sun.

It will be noted that the lamb last born was just two months old when turned out; the others being 2 months and 3 days, and two and one-half months, respectively.

The lambs grazed regularly over the pasture lot, getting the little grain daily, as mentioned, to supply some of the nourishment (protein) for growth, of which they were deprived when the mother's milk was cut off, and were occasionally given a few sweet potato vines, of which they seemed passionately fond. They remained in perfect health, with no evidences, whatever, of parasitism, and on January 9, 1904, after being on pasture for a period of 6 months, 22 days (June 18, 1903 to Jan. 9, 1904), they were slaughtered and dressed by a local butcher, who purchased them. A careful post-mortem examination was made of the intestines of each lamb, but with negative results. That is, not the sign of a nodule could be found.

Some authorities have suggested the possibility, or even probability, of lambs obtaining infection from the mother's udder (bag) when nursing, the parasites being attached to some part of that organ. We do not doubt the possibility for this mode of transmission, when the ewes and lambs occupy pastures that are

infected, the bag and teats of the mother coming in contact with the egg or worm infected ground. But, although all of the ewes from which we secured our experiment lambs were severely affected with nodule disease, none of the lambs, or, at all events, neither the two "controls", in the first part of the work, nor the three in the last part, could have been infected in this way, as proved by perfectly "clean" intestines when the autopsies were made. It may be, however, that the conditions, under which the ewes were kept with us, precluded the possibility of infection in this way. Yet, no special attention was paid to the absolute cleanness of the ewes compartment, and which was at times sufficiently foul with droppings to favor contamination of their bags and teats, when resting on the ground. Such, however, evidently did not occur in our case.

The conclusions deducible from the results of the experiments may be stated as follows:

(1). That sheep suffering from Nodular Disease of the Intestines, when placed upon a hitherto clean pasture, transmit infection to it through extrusion of the nodule-worm (Oesophagostoma Columbianum) from their bowels, probably with their droppings.

(2). That when sound lambs are permitted to occupy a pasture so infected, they will contract nodule disease.

(3). That when the surface of an infected pasture is turned under by ploughing, and the land cropped, even for a single season, the infection may be destroyed.

(4). That when sound lambs are allowed to occupy and graze upon a pasture (previously infected) after being cultivated and cropped, as above mentioned, they will remain free from nodule disease.

(5). That lambs, the progeny of ewes affected with nodule disease of the intestines, can be raised free from this disease, provided proper methods are adopted to prevent contamination, and,

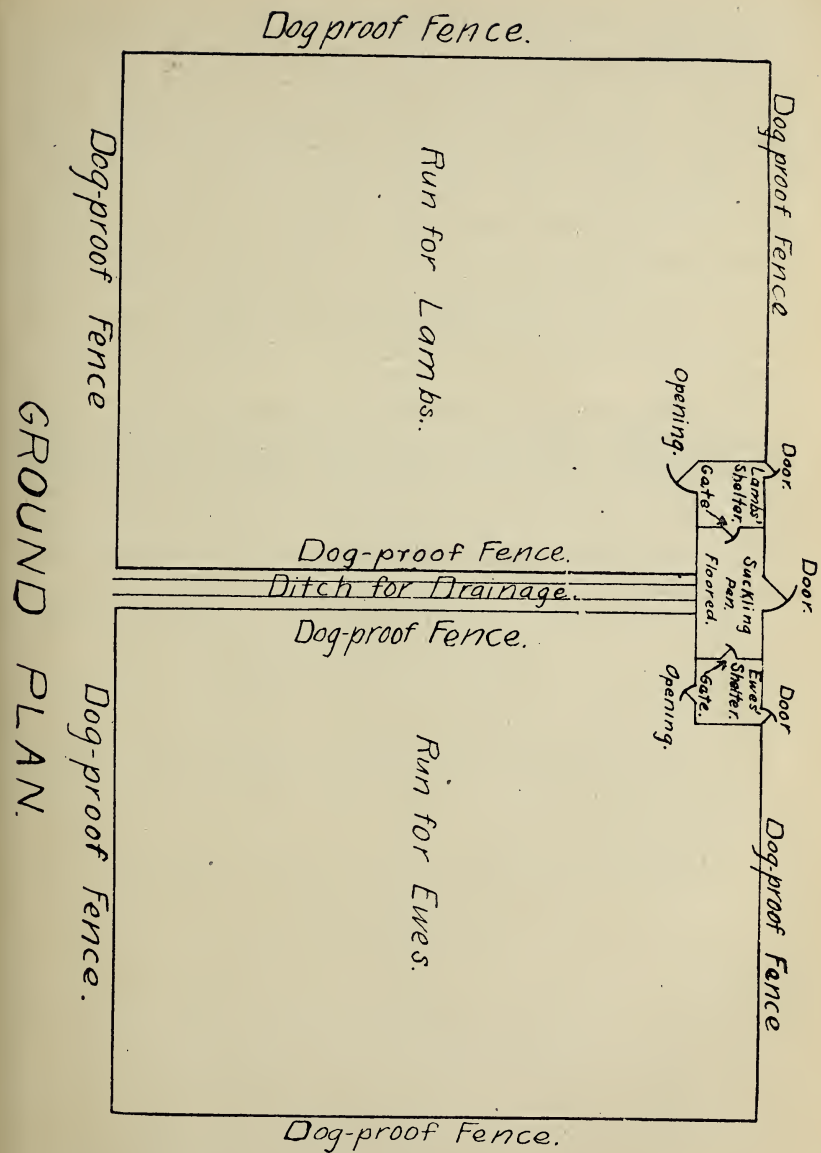
(6). That, if an infected pasture is placed in cultivation for a time, to destroy the parasites on it; clean lambs raised, as suggested by the method adopted by us, or purchased and known to be clean, and all affected sheep disposed of for slaughter (this ailment being confined to the intestines mainly, and not rendering the flesh unsafe as an article of human food), the disease may eventually be eradicated from both the land and the flock.

As stated above, these conclusions have been arrived at from the results of our experiment only. For further information with respect to Nodular Disease in Sheep, and its treatment in that animal, we would respectfully refer our readers either to our article on the subject in the first part of this bulletin, or to other works treating of this ailment.

Owing to the fact that probably the majority of sheep butchered in different parts of the State seem to show nodules on their intestines, it would appear that our old sheep pasture lands, or ranges, are very generally infected with the parasites of this disease; and so long as the sheep remain on these feeding grounds, so long will the disease exist, by the animals becoming infected, and, in turn, re-infecting the land and themselves. When the time comes, however, for such lands to be placed in cultivation, and take their part in a regular system of crop rotation, we will then have little difficulty in predicting the material reduction, if not the extermination, of this, as well as other internal parasitic diseases of the sheep. But, even under existing conditions, it is questionable whether it would not be more profitable to abandon the keeping of large flocks of diseased and scrubby animals on the old infected ranges, and have fewer, but better and more valuable ones of the improved breeds, on the farm—rather than on the range—where their feeding grounds could be periodically changed, which is inimical to the development of worms, and the sheep cared for and handled in an intelligent manner for the profit that may be obtained from them. Sheep husbandry is a profitable branch of agricultural industry, when conducted in a business-like way. But when sheep are neglected, there is no variety of domestic animal that will degenerate more rapidly, or succumb to the ravages of parasitic invasion more readily, with failure and loss as the inevitable result. Consequently, whoever hopes to succeed in the sheep-growing business, must become educated to its conditions and requirements, as has to be done by those engaged in, and make a success of, other branches of industry.

The following diagram and explanations also appeared in Bulletin No. 74, but as we deem these pertinent to the subject under consideration, their reproduction here will doubtless further add to the completeness of this report.

In order to suggest a practical method by which sound lambs may be obtained from infected mothers, we append the following diagram and suggestions:



First of all a piece of land should be chosen not previously occupied by sheep, on which to erect the shed and runs. The shed should be divided into three compartments, the ewes occupying one end and the lambs the other, the middle one being kept for a

suckling pen, as previously described. The floor of the compartments should be such that it can be easily cleansed and kept free of accumulated manure, and any material that would harbor the parasites. Two runs should be constructed at right angles to the shed, one connected with the ewes' compartment, the other with the lambs', while a space should remain between the runs, sufficiently wide to prevent contamination from the ewes to the lambs. Each run should be protected with dog-proof fencing, and both should be thoroughly drained, with the object, first, of preventing infection (the parasites) being washed from the ewes' run to the lambs'; and second, of keeping both dry. The size of the construction would have to be determined, of course, by its requirements.

After raising a crop of sound lambs each year, by this, or other suitable method, the diseased ewes could be gradually disposed of by marketing, and the infection lessened in this way from time to time. And, if the lambs, after weaning, were placed upon sound pasture, or other provision made for them, it need not be long before a sound flock might be raised from one badly affected with nodular disease.